(Amended under PCT 34)

[0008]

In the above-described conventional illumination adjustment circuit, the constant voltage (V2) generated in the zener diode (D1) is used as a reference voltage, and such a constant voltage (V2) is switched and smoothened so as to generate a DC voltage (VB) for adjusting a potential at the base of the driving transistor (Q1). As a result, it becomes possible to perform an adjustment on the illuminating lamp (FL) to ensure a constant illuminance, without being influenced by a voltage fluctuation of the power supply (Vcc).

[0009]

However, when a fluctuation occurs in the power supply (Vcc) and a voltage level rises up, since the potential at the base of the driving transistor (Q1) is maintained at a constant level by virtue of the DC voltage (VB), a voltage between the collector and the base of the driving transistor (Q1) will also rise, resulting in a problem that the transistor's collector loss is large.

[0010]

In particular, when driving/controlling an illuminating lamp (FL) which requires a large electric power consumption, once a voltage level of a power supply (Vcc) rises up, a load on the driving transistor(Q1) will increase, thus causing a rapid increase in the collector loss of the driving transistor(Q1), or a deterioration in the characteristic of the driving transistor(Q1), which is caused possibly due to a heat generation, hence bringing about a problem of causing a wound or the like.

[0011]

The present invention has been accomplished in view of the above-discussed conventional problem and it is an object of the invention to provide an illumination control circuit having a driving element for driving an illuminating lamp, a light emitting lamp, a light emission element or the like, thereby ensuring an improved illumination control circuit capable of reducing a load on the driving element, even if there has been a fluctuation or the like on the power source voltage.

[0012]

Another object of the invention is to provide an improved illumination control circuit capable of stabilizing a brightness such as an illuminance and a light intensity of an illuminating lamp, a light emitting lamp, and a light emission element or the like, even if there has been a fluctuation or the like on the power source voltage.

Means for Solving the Problem

[0013]

An invention recited in claim 1 is an illumination control circuit for driving and controlling a light emission element, the circuit comprising: generating means for generating a control signal of DC voltage for setting a brightness of the light emission element; a driving transistor connected in series with the light emission element and a power supply, for supplying a driving electric power from the power supply to the light emission element in accordance with the control signal, thereby causing the light emission element to emit a light; detecting means for detecting a differential voltage

between a power source voltage of the power supply and a predetermined reference voltage, dividing the differential voltage with an adjustable coefficient, thereby generating a detection voltage; and compensation means connected in series with the light emission element and the driving transistor as well as the power supply, for power-amplifying the detection voltage and generating a compensation voltage which follows the detection voltage, thereby generating a differential voltage between the power source voltage of the power supply and the compensation voltage, between tow ends of the light emission element and the driving transistor. In particular, when there is a change in the power source voltage of the power supply, the compensation means generates a compensation voltage, so as to make a changing rate of the differential voltage applied between tow ends of the light emission element and the driving transistor, to become smaller than a changing rate of the power source voltage which has involved a change.

[0014]

An invention recited in claim 7 is an illumination control circuit for driving and controlling a light emission element, the circuit comprising: a driving transistor connected in series with the light emission element and a power supply; detecting means for detecting a differential voltage between a power source voltage of the power supply and a predetermined reference voltage, and generating a detection voltage formed by adding a voltage divided by dividing the differential voltage with an adjustable coefficient and the reference voltage; a switching element for switching the detection voltage in accordance with PWM signal for setting a

brightness of the light emission element, and outputting a switching signal; smoothing means for smoothing the switching signal and generating a control signal of DC voltage; and compensation means for controlling the driving transistor in accordance with a DC voltage of the control signal, and causing the power supply to supply a driving voltage proportional to the DC voltage to the light emission element. In particular, when there is a change in the power source of the power supply, the DC voltage of the control signal changes at a changing rate smaller than a changing rate of a changed power source voltage in accordance with the coefficient, thereby inhibiting a driving electric power of the driving transistor on the light emission element in accordance with the coefficient.

Brief Description of the Drawings

[0015]

Fig. 1 is a circuit diagram showing a structure of an illumination control circuit according to a first embodiment of the present invention.

Fig. 2 provides characteristic graphs explaining basic properties of the illumination control circuit shown in Fig. 1.

Fig. 3 is a circuit diagram showing a structure of an illumination control circuit according to a second embodiment.

Fig. 4 is a circuit diagram showing a structure of an illumination control circuit according to a first example.

Fig. 5 is a circuit diagram showing a structure of an illumination control circuit according to a second example.

Best Mode of Carrying Out the Invention

[0016]

Next, description will be given to explain two embodiments of the illumination control circuit of the present invention, with reference to Figs. 1 to 3.

[0017]

[Embodiment 1]

Fig. 1 is a circuit diagram showing a structure of an illumination control circuit according to a first embodiment of the present invention.

As shown in Fig. 1, the illumination control circuit 1 comprises a control signal source 2, a switching element 3 serving as a control element, a smoothing unit 4, a driving element 5, a reference unit 6, a detecting unit 7, and a compensating unit 8. When the illumination control circuit 1 is connected to a power source PWR such as a vehicle battery mounted in a vehicle, the illumination control circuit 1 will operate to control the illuminance or the light intensity of an illuminating lamp, a light emitting lamp and a light emission element FL which all receive an electric power supplied from the power source PWR and thus emit light.

[0018]

In the following, for an easy description, an illuminating lamp, a light emitting lamp and a light emission element will all be simply referred to as "light emission element".

[0019]

The control signal source 2 is formed of an oscillating circuit outputting PWM signal S1, and can variably adjust a pulse width (a pulse width when the signal becomes logically "H") of the PWM signal S1 by virtue of an external operation. In other words, the

control signal source 2 can variably adjust the duty of the PWM signal S1 by an external operation.

[0020]

The switching element 3 performs a switching operation in accordance with the PWM signal S1 and outputs a square wave switching signal S2 logically inverted with respect to the PWM signal S1.

Claims

1 (Amended). An illumination control circuit for driving and controlling a light emission element, said circuit comprising:

generating means for generating a control signal of DC voltage for setting a brightness of the light emission element;

a driving transistor connected in series with the light emission element and a power supply, for supplying a driving electric power from the power supply to the light emission element in accordance with said control signal, thereby causing the light emission element to emit a light;

detecting means for detecting a differential voltage between a power source voltage of the power supply and a predetermined reference voltage, dividing the differential voltage with an adjustable coefficient, thereby generating a detection voltage; and

compensation means connected in series with the light emission element and the driving transistor as well as the power supply, for power-amplifying the detection voltage and generating a compensation voltage which follows the detection voltage, thereby generating a differential voltage between the power source voltage of the power supply and the compensation voltage, between tow ends of the light emission element and the driving transistor,

wherein when there is a change in the power source voltage of the power supply, the compensation means generates a compensation voltage, so as to make a changing rate of the differential voltage applied between tow ends of the light emission element and the driving

transistor, to become smaller than a changing rate of the power source voltage which has involved a change.

2 (Amended). The illumination control circuit according to claim 1, wherein said detecting means has voltage dividing resistor capable of adjusting said coefficient, divides said differential voltage by virtue of voltage dividing resistor, and generates a divided voltage.

3 (Amended). The illumination control circuit according to claim 2, wherein said detecting means has an electronic element for generating said reference voltage, said electronic element and voltage dividing resistor are connected in series with respect to the power source voltage of the power supply.

4 (Amended). The illumination control circuit according to any one of claims 1 to 3, wherein the DC voltage of control signal is adjustable.

5 (Cancelled).

6 (Amended). The illumination control circuit according to any one of claims 1 to 4,

wherein said compensation means is formed of a transistor which performs a power amplification and generates said compensation voltage in accordance with said detection voltage;

wherein said generating means has smoothing means for smoothing

a duty-adjustable switching signal and generating the control signal of DC voltage.

7 (Amended). An illumination control circuit for driving and controlling a light emission element, said circuit comprising:

a driving transistor connected in series with said light emission element and a power supply;

detecting means for detecting a differential voltage between a power source voltage of the power supply and a predetermined reference voltage, and generating a detection voltage formed by adding a voltage divided by dividing said differential voltage with an adjustable coefficient and said reference voltage;

a switching element for switching said detection voltage in accordance with PWM signal for setting a brightness of said light emission element, and outputting a switching signal;

smoothing means for smoothing said switching signal and generating a control signal of DC voltage; and

compensation means for controlling said driving transistor in accordance with a DC voltage of the control signal, and causing said power supply to supply a driving voltage proportional to the DC voltage to said light emission element,

wherein when there is a change in the power source of the power supply, the DC voltage of the control signal changes at a changing rate smaller than a changing rate of a changed power source voltage in accordance with said coefficient, thereby inhibiting a driving electric power of said driving transistor on said light emission element in accordance with said coefficient.

8 (Amended). The illumination control circuit according to claim 7, wherein said detecting means has voltage dividing resistor capable of adjusting said coefficient, divides said differential voltage by virtue of voltage dividing resistor, and generates a divided voltage.

9 (Amended). The illumination control circuit according to claim 7 or 8, wherein the compensation means is a transistor for controlling a control current of the driving transistor in accordance with the DC voltage of the control signal.